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ABSTRACT

This study examined how students with a minimum background of Calculus IV (n=17) differ from other college students (n=17) on personality traits as determined by the 16 PF, fifth edition. Significant differences were found on Factor A (Warmth), Factor B (Reasoning), Factor F (Liveliness) and Factor H (Social Boldness). Gender differences were also investigated, both within each group, and across groups. No significant differences were found between males and females in the calculus group. However, males and females in the control group significantly differed on Factor L (Vigilance) and Factor Q1 (Openness to Change). Males in the calculus group differed significantly from males in the control group on Factor F (Liveliness). Females in these two groups significantly differed on Factor A (Warmth) and Factor B (Reasoning). Contains five tables. (Author)

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Personality Traits of Mathematically Advanced College Students

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Abstract

This study examined how students with a minimum background of Calculus IV (n = 17) differ from other college students (n = 17) on personality traits as determined by the 16 PF, fifth edition (Cattell, Cattell, & Cattell, 1994). Significant differences were found on Factor A (Warmth), Factor B (Reasoning), Factor F (Liveliness) and Factor H (Social Boldness). Gender differences were also investigated, both within each group, and across groups. No significant differences were found between males and females in the calculus group. However, males and females in the control group significantly differed on Factor L (Vigilance) and Factor Q1 (Openness to Change). Males in the calculus group differed significantly from males in the control group on Factor F (Liveliness). Females in these two groups significantly differed on Factor A (Warmth) and Factor B (Reasoning).

Personality Traits of Mathematically Advanced College Students

Choosing a major in college is often a difficult process for students. They try something that sounds very interesting only to discover that it is not really suited to them at all. One way to explain this is in differences in personality traits. For example, an individual who pursues higher mathematics such as calculus, tends to show certain personality characteristics (Siegel & Shaughnessy, 1992).

Kazi and Piper (1983) examined the personality traits of science teachers and medical technologists. Both groups complete similar course requirements then go in different career directions. They (Kazi & Piper, 1983) found that these two groups did indeed possess different personality traits.

Another study by Barker (1989) found that Civil Engineers differed from the normal population on five of 20 factors when the British Norms version of the 16 PF was administered. This provided a means by which students could be selected for civil engineering courses.

Odom and Shaughnessy (1989) examined personality factors of high school students in advanced placement mathematics. Factor E (Dominance) was found to be a significant personality factor for the entire group. Gender differences were also investigated. Males scored higher on Factor A (Warmth) and Factor E (Dominance), while females scored higher on Factor E (Dominance), Factor H (Social Boldness), Factor L (Vigilance), and Factor O (Apprehension).

If certain personality traits could be identified in college students who succeed in a particular academic discipline, then career counselors and academic advisors would have

another tool at their disposal to help students make decisions regarding careers and academic majors.

The hypotheses for this research are as follows:

1. Significant differences exist between the Calculus IV-minimum group and the control group.
2. Males and females in each group significantly differ on one or more personality factors.
3. Males and females across groups differ significantly on one or more personality factors.

Method

Subjects

The specific population of interest was all students with a minimum background of Calculus IV at a small southwestern public university. The control group population was all students at this same university.

The sample for the treatment group was drawn from Numerical Analysis II (n = 12) over a period of two years and Optics (n = 5). Numerical Analysis II has a prerequisite of Calculus IV and the subjects from Optics reported that they were either currently enrolled in Calculus IV or had already taken it. There were 11 males and six females in this group. The control group was sampled from an introductory psychology class (n=17). This sample consisted of eight males and nine females.

Both were samples of convenience since the instructors of these courses agreed to make their students available to the researcher. Since obtaining a random sample was not possible, the

sample sizes were equalized. Equal sample sizes create robustness with regard to the equal sample variances assumption for the two sample independent t test.

Apparatus

The different personality traits were measured using the Cattell, Cattell, and Cattell 16 PF, fifth edition (1994). The instrument was hand-scored using templates and interpreted using its norming tables.

Procedures

The 16 PF was administered during a regular class meeting time for all subjects except those in Numerical Analysis II who were tested during the second year of data collection (n=5). These subjects signed up for testing times outside of class and were tested in a small office setting.

Results

A MANOVA procedure was conducted to determine if real differences between the treatment and control groups were present. This procedure was chosen because some factors on the 16 PF are intercorrelated (Cattell et al., 1994). With an alpha level of .05, significant differences were detected, $F(16, 17) = 2.41$, $p = .0405$.

Since significant differences were detected using the MANOVA procedure, independent t tests were used to determine on which of the 16 personality factors the calculus group and the control group differed.

The Calculus IV-minimum group significantly differed from the control group at $\alpha = .05$ on Factor A (Warmth), $t(32) = -3.12$, $p = .004$; Factor B(Reasoning), $t(32) = 2.84$, $p = .008$;

Factor F (Liveliness), $t(32) = -2.52$, $p = .017$; and, Factor H (Social Boldness), $t(32) = -2.14$, $p = .04$. The means and standard deviations for both groups are presented in Table 1.

Independent t tests showed no significant difference on personality factors between males and females in the calculus group. However, significant differences between males and females were found for the control group. These significant differences at $\alpha = .05$ were on Factor L (Vigilance), $t(15) = 2.18$, $p = .046$, and Factor Q1 (Openness to Change), $t(15) = 2.58$, $p = .021$. Descriptive statistics for the treatment and control groups by gender are shown in Tables 2 and 3, respectively.

Differences for each gender across groups were then investigated also using independent t tests. For males, a significant difference at an alpha level of .05 was found between the calculus group and the control group on Factor F (Liveliness), $t(17) = -2.54$, $p = .021$. Females across groups significantly differed on Factor A (Warmth), $t(13) = -2.31$, $p = .038$, and Factor B (Reasoning), $t(13) = 2.59$, $p = .022$. Means and standard deviations are presented in Tables 4 and 5.

Discussion

The group with a calculus IV background were more "reserved, impersonal, [and] distant" (Russell & Karol, 1994, p. 18) than the control group. In addition, their reasoning abilities appeared to be more abstract. On Factor F, the math group tended to be more "serious, restrained, [and] careful" (Russell & Karol, 1994, p.18) than the introductory psychology group. With regard to Social Boldness, the math group was more "shy, threat-sensitive, [and] timid" (Russell & Karol, 1994, p.18) than the control group.

Gender differences in the calculus group were not apparent from this study. However, gender differences were seen in the control group. On Factor L, males were more "vigilant, suspicious, skeptical, [and] wary" (Russell & Karol, 1994, p.18) than females. Males also tended to be more open to change than females.

When males in the calculus group were compared with males in the control group, the males in the calculus group appeared to be more "serious, restrained, [and] careful" (Russell & Karol, 1994, p.18) than the males in the control group. Females in the calculus group were more "reserved, impersonal, [and] distant" (Russell & Karol, 1994, p. 18) than the females in the control group. Likewise, females in the calculus group scored higher on abstract reasoning abilities than those in the control group.

The differences between males and females is very interesting, especially those differences between females in each of the groups. While females appear to differ on abstract reasoning abilities, males do not. This difference could be an important issue for teachers and counselors working with female students.

The results of this study differ somewhat from the findings of Siegel and Shaughnessy (1992) who found that students with calculus experience scored highest on Factor E (Dominance) and Factor L (Vigilance). As a group these students seem to be more reserved, tend to reason more abstractly than the normal population, and appear to be more imaginative or focused on ideas (Russell & Karol, 1994).

These differences may be due to different editions of the 16 PF being used (Cattell, 1969; Cattell et al., 1994), the smaller sample size of this study, or because only students who were at a minimum currently taking Calculus IV were examined in this study. This last point may be of

particular relevance because in the study by Siegel and Shaughnessy (1992) only students in Calculus I, II, and III were studied and of these, 56 were in Calculus I, 20 were in Calculus II, and only six were in Calculus III. No students in Calculus IV or higher were included in this study (Siegel & Shaughnessy, 1992). More research is needed into the personality of "high math" students.

What may be occurring is that students who succeed in "higher" mathematics differ in their personality traits from those students who are required to take only one or two semesters of calculus. This finding may be masked in the study by Siegel and Shaughnessy (1992) due to the much larger numbers of Calculus I and II students examined.

In conclusion, there are significant personality differences between students who study higher mathematics and other students. In addition, there appear to be differences between males and females with regard to which of these personality characteristics are significantly different. One should use caution with this last statement because the sample sizes involved were small, and unequal in size. Obtaining large samples from a population that is small to begin with is a fundamental problem when studying this particular group and should also be taken into consideration in this type of research.

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Table 1

Descriptive Statistics for Calculus IV-Minimum Background Group and the Control Group

Factor	Calculus Group (n = 17)		Control Group (n = 17)		t
	M	SD	M	SD	
A	3.88	1.73	5.88	2.00	-3.12**
B	6.88	1.58	5.18	1.91	2.84**
C	5.41	1.77	5.76	1.68	-0.60
E	6.29	1.90	6.24	1.92	0.09
F	5.65	2.00	7.18	1.51	-2.52*
G	5.12	1.87	5.12	1.96	0.00
H	5.00	1.70	6.29	1.83	-2.14*
I	4.76	1.92	4.18	2.01	0.87
L	6.35	1.87	6.47	1.55	-0.20
M	6.06	1.43	5.41	2.00	1.08
N	5.65	1.62	5.59	2.24	0.09
O	5.29	1.45	5.18	1.59	0.23
Q1	6.00	2.94	5.12	1.76	1.06
Q2	5.65	1.73	5.24	1.89	0.66
Q3	5.18	1.78	5.35	1.66	-0.30
Q4	5.53	1.97	5.53	1.94	0.00

*p < .05. **p < .01.

Table 2

Descriptive Statistics for Calculus IV-Minimum Background Group by Gender

Factor	Males (n = 11)		Females (n = 6)		t
	M	SD	M	SD	
A	3.82	1.40	4.00	2.37	-0.20
B	6.55	1.69	7.50	1.22	-1.21
C	5.82	1.47	4.67	2.16	1.31
E	6.64	1.63	5.67	2.34	1.01
F	5.27	1.90	6.33	2.16	-1.05
G	5.55	1.97	4.33	1.51	1.31
H	5.27	1.85	4.50	1.38	0.89
I	4.73	2.28	4.83	1.17	-0.11
L	6.55	1.97	6.00	1.79	0.56
M	6.45	0.93	5.33	1.97	1.62
N	6.09	1.51	4.83	1.60	1.61
O	4.82	1.25	6.17	1.47	-2.00
Q1	6.09	3.05	5.83	2.99	0.17
Q2	6.00	1.55	5.00	2.00	1.15
Q3	5.27	1.49	5.00	2.37	0.29
Q4	5.00	1.90	6.50	1.87	-1.56

*p < .05. **p < .01.

Table 3

Descriptive Statistics for Control Group by Gender

Factor	Males (n = 8)		Females (n = 9)		t
	M	SD	M	SD	
A	5.25	2.19	6.44	1.74	-1.25
B	5.38	1.77	5.00	2.12	0.39
C	6.00	2.07	5.56	1.33	0.53
E	6.75	1.98	5.78	1.86	1.04
F	7.25	1.28	7.11	1.76	0.18
G	4.88	1.81	5.33	2.18	-0.47
H	6.50	1.69	6.11	2.03	0.43
I	4.00	2.20	4.33	1.94	-0.33
L	7.25	1.04	5.78	1.64	2.18*
M	5.50	1.69	5.33	2.35	0.17
N	6.37	2.20	4.89	2.15	1.41
O	5.25	2.05	5.11	1.17	0.17
Q1	6.13	1.13	4.22	1.79	2.58*
Q2	5.88	1.46	4.67	2.12	1.35
Q3	5.38	1.85	5.33	1.58	0.05
Q4	5.62	2.20	5.44	1.81	0.19

*$p < .05$. **$p < .01$.

Table 4

Descriptive Statistics for Males by Group

Factor	Calculus Group (n = 11)		Control Group (n = 8)		t
	M	SD	M	SD	
A	3.82	1.40	5.25	2.19	-1.74
B	6.55	1.69	5.38	1.77	1.46
C	5.82	1.47	6.00	2.07	-0.22
E	6.64	1.63	6.75	1.98	-0.14
F	5.27	1.90	7.25	1.28	-2.54*
G	5.55	1.97	4.88	1.81	0.76
H	5.27	1.85	6.50	1.69	-1.48
I	4.73	2.28	4.00	2.20	0.70
L	6.55	1.97	7.25	1.04	-0.92
M	6.45	0.93	5.50	1.69	1.58
N	6.09	1.51	6.37	2.20	-0.33
O	4.82	1.25	5.25	2.05	-0.57
Q1	6.09	3.05	6.13	1.13	-0.03
Q2	6.00	1.55	5.88	1.46	0.18
Q3	5.27	1.49	5.38	1.85	-0.13
Q4	5.00	1.90	5.62	2.20	-0.66

*$p < .05$. **$p < .01$.

Table 5

Descriptive Statistics for Females by Group

Factor	Calculus Group (n = 6)		Control Group (n = 9)		t
	M	SD	M	SD	
A	4.00	2.37	6.44	1.74	-2.31*
B	7.50	1.22	5.00	2.12	2.59*
C	4.67	2.16	5.56	1.33	-.099
E	5.67	2.34	5.78	1.86	-0.10
F	6.33	2.16	7.11	1.76	-0.77
G	4.33	1.51	5.33	2.18	-0.97
H	4.50	1.38	6.11	2.03	-1.69
I	4.83	1.17	4.33	1.94	0.56
L	6.00	1.79	5.78	1.64	0.25
M	5.33	1.97	5.33	2.35	0.00
N	4.83	1.60	4.89	2.15	-0.05
O	6.17	1.47	5.11	1.17	1.55
Q1	5.83	2.99	4.22	1.79	1.31
Q2	5.00	2.00	4.67	2.12	0.30
Q3	5.00	2.37	5.33	1.58	-0.33
Q4	6.50	1.87	5.44	1.81	1.09

*$p < .05$. **$p < .01$.